

Figure 1. System Configuration of Clustered Video Server System

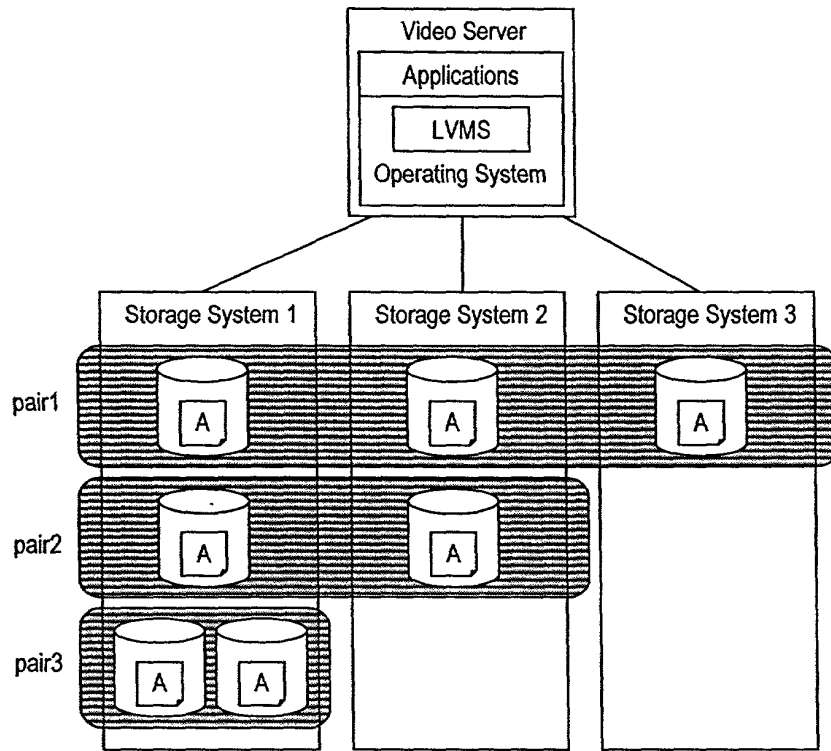


Figure 2. Example of Disk Mirroring on Multiple Storage Systems by LVMS

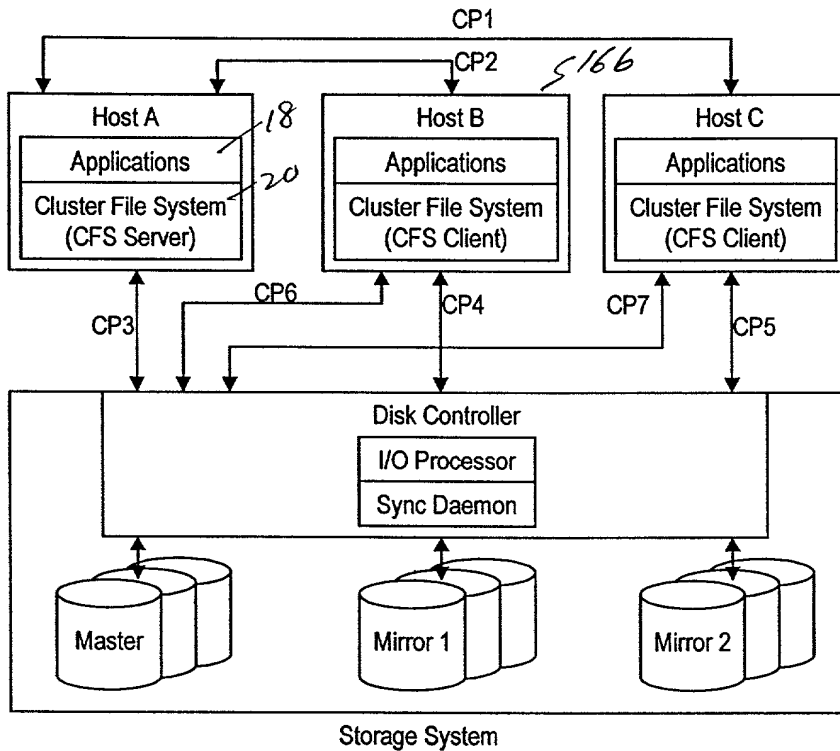


Figure 3 System Configuration where Mirrors in the Same Storage System

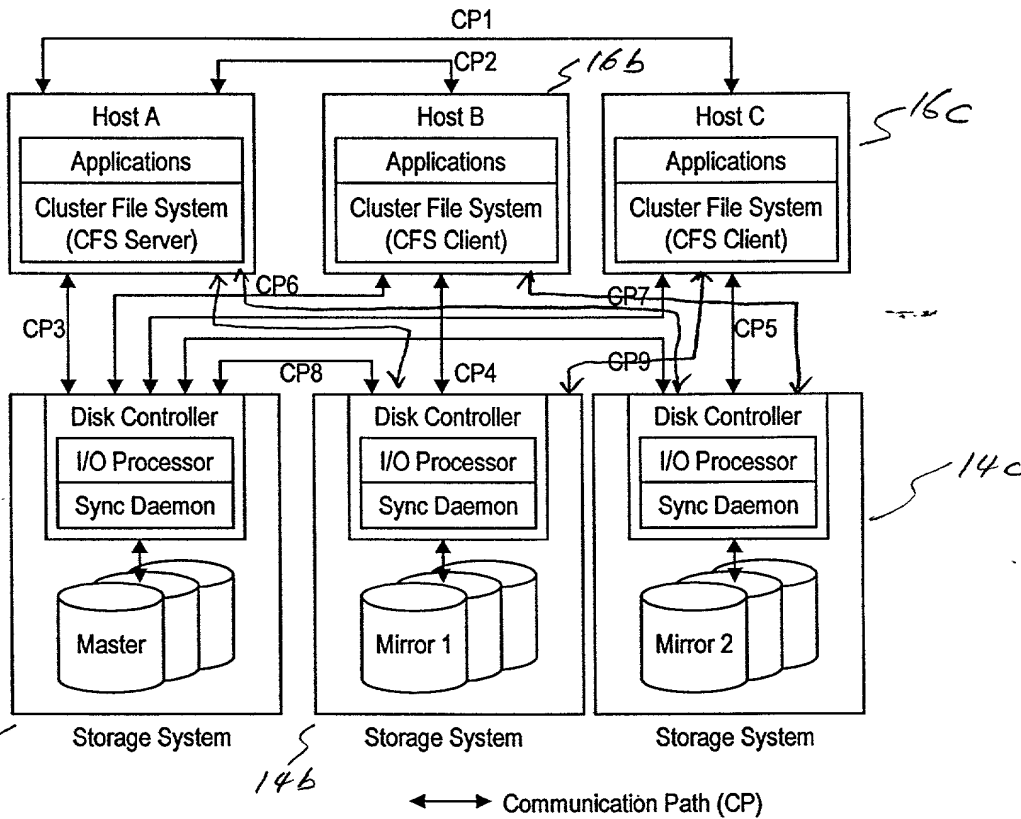


Figure 4. System Configuration of Second Description

| Pair Name | Master |        | Mirror 1 |        | Mirror 2 |        | ..... |
|-----------|--------|--------|----------|--------|----------|--------|-------|
|           | SS ID  | Vol ID | SS ID    | Vol ID | SS ID    | Vol ID |       |
| pair1     | 1      | 8      | 2        | 2      | 3        | 5      | ..... |
| pair2     | 1      | 12     | 1        | 7      | N/A      | N/A    | ..... |
| ⋮         | ⋮      | ⋮      | ⋮        | ⋮      | ⋮        | ⋮      |       |

Figure 5. Pair Configuration Table

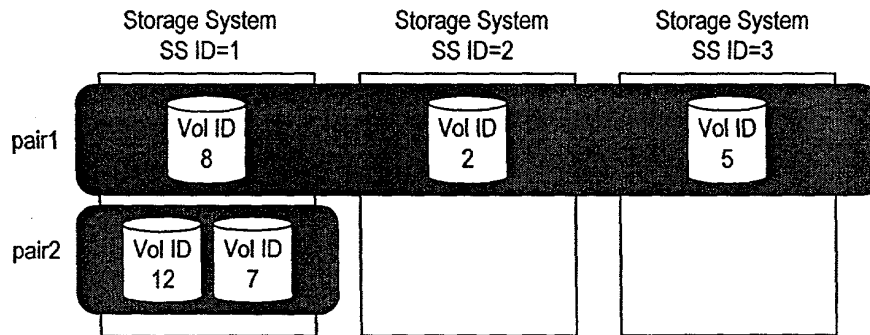


Figure 6. Graphical Understanding about Mirroring Configuration

| Pair Name | Master | Mirror 1 | Mirror 2 | ..... |
|-----------|--------|----------|----------|-------|
| pair1     | 100    | 200      | 50       | ..... |
| pair2     | 300    | 10       | N/A      | ..... |
| ⋮         | ⋮      | ⋮        | ⋮        |       |

Figure 9. Usage Table of Pairs

| File Name | Block #1 |        |        | Block #2 |        |        | Block #3 |        |        | ..... |
|-----------|----------|--------|--------|----------|--------|--------|----------|--------|--------|-------|
|           | SS ID    | Vol ID | Offset | SS ID    | Vol ID | Offset | SS ID    | Vol ID | Offset |       |
| file1     | 1        | 8      | 100    | 1        | 8      | 700    | 1        | 8      | 900    | ..... |
| file2     | 1        | 8      | 200    | 1        | 8      | 150    | 1        | 8      | 600    | ..... |
| file3     | 1        | 12     | 10     | 1        | 12     | 80     | 1        | 12     | 100    | ..... |
| ⋮         | ⋮        | ⋮      | ⋮      | ⋮        | ⋮      | ⋮      | ⋮        | ⋮      | ⋮      | ⋮     |

Figure 7. File Allocation Table of CFS Server

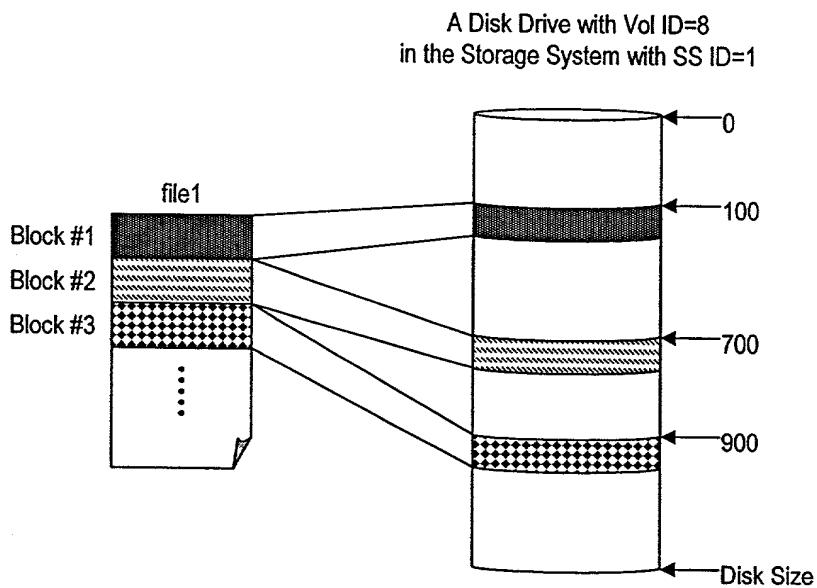


Figure 8 Graphical Understanding about File Allocation List

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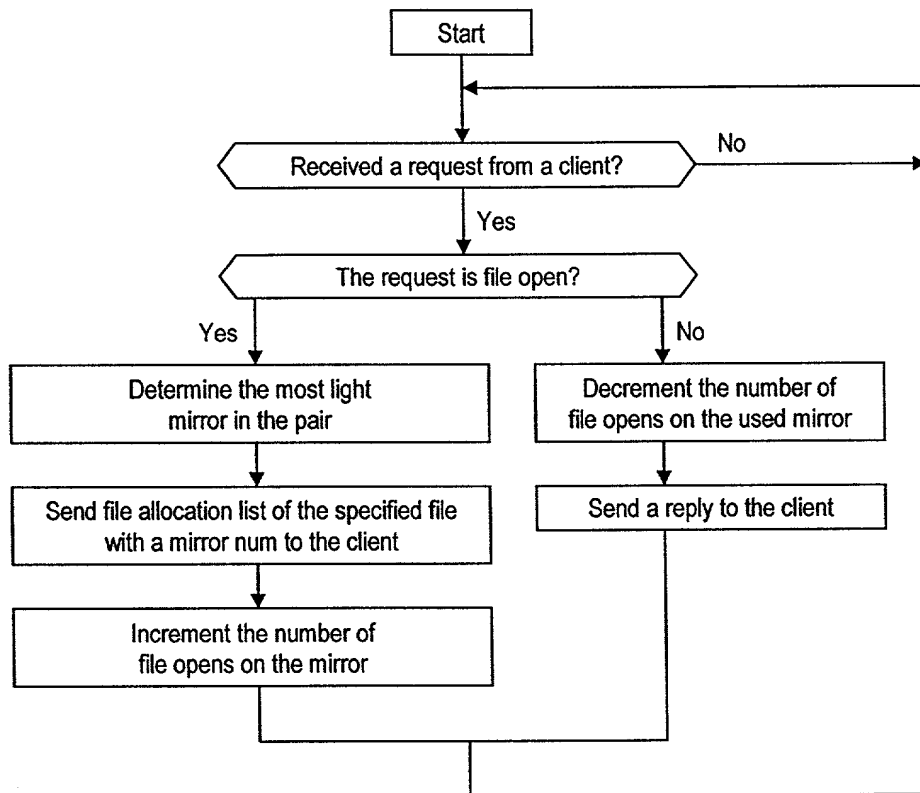


Figure 10 Process Sequence of CFS Server

```
struct {  
    int mirror_num;  
    int block_num;  
    struct {  
        int master_ss_id;  
        int master_vol_id;  
        int offset;  
    } block_list[block_num];  
} file_allocation_list
```

Figure 11. The Format of File Allocation List

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```
struct {  
    int type;  
    union {  
        struct {  
            char *filename;  
            int mode;  
        } open;  
        struct {  
            int file_id;  
            int offset;  
            int size;  
            char *buf;  
        } write;  
        struct {  
            int file_id;  
            int offset;  
            int size;  
            char *buf;  
        } read;  
        struct {  
            int file_id;  
        } close;  
    } u;  
} file_io_request
```

Figure 12. File I/O Request Format

```
#define File_Open 1  
#define File_Write 2  
#define File_Read 3  
#define File_Close 4
```

Figure 13. File I/O Type

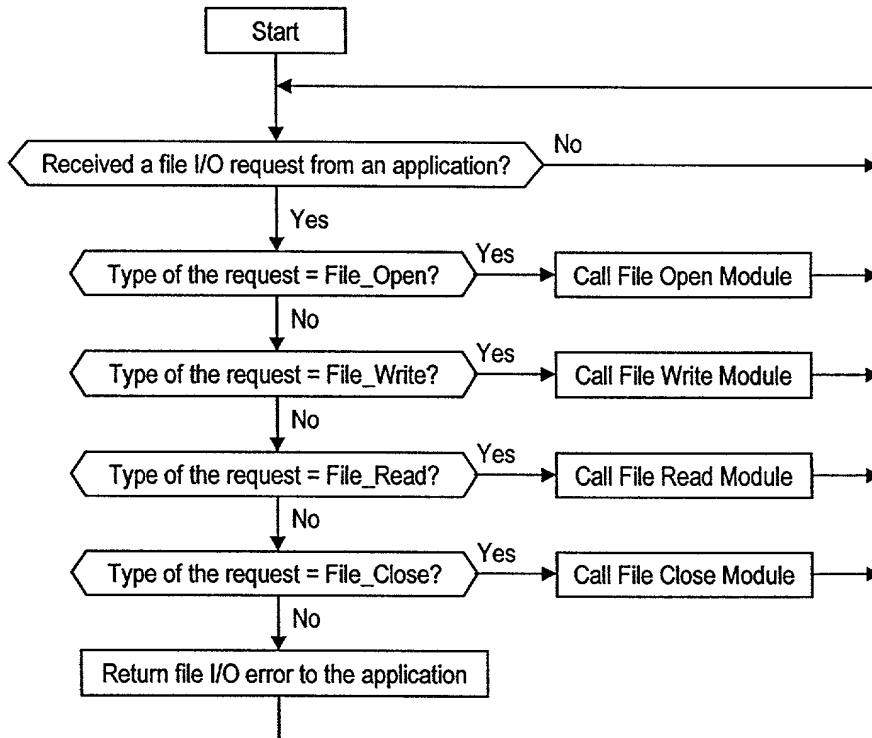


Figure 19 Process Sequence of CFS Client

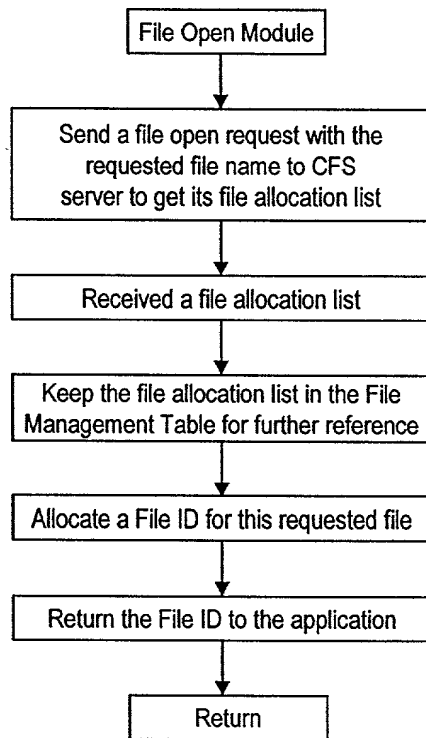


Figure 15. File Open Module

```
struct {  
    struct file_allocation_list *fal;  
} file_mgmt_table[max_file_id];
```

Figure 16. File Management Table

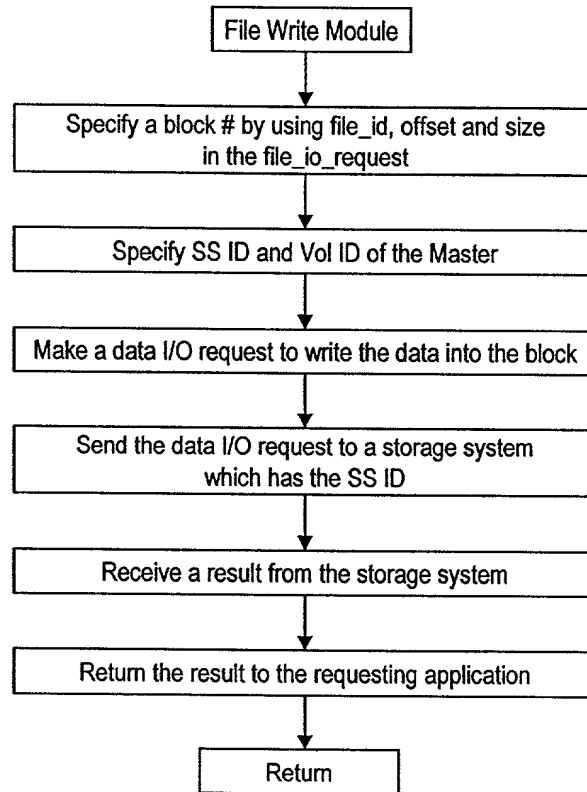


Figure 17. File Write Module

```
struct {  
    int type;  
    int vol_id;  
    int offset;  
    int size;  
    char *data;  
} data_io_request
```

Figure 18. Data I/O Request

```
#define Data_Read    1  
#define Data_Write  2
```

Figure 19. Types of Data I/O Request

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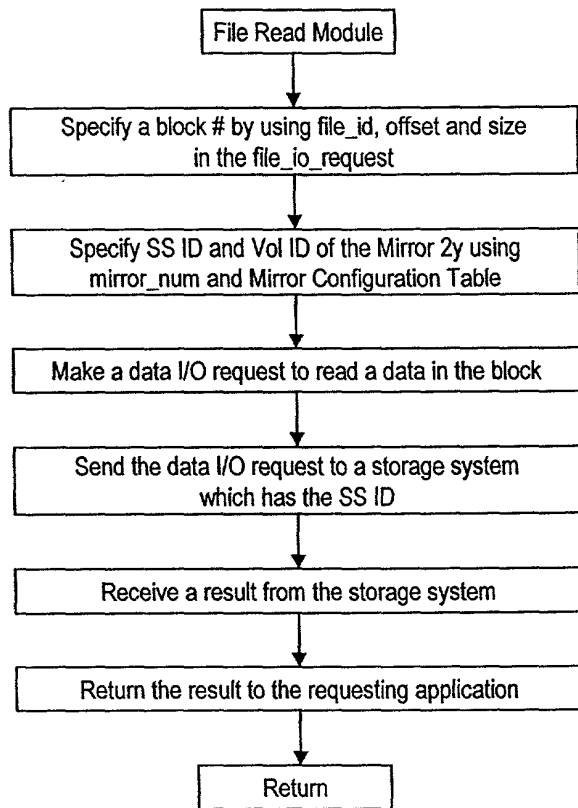


Figure 20 File Read Module

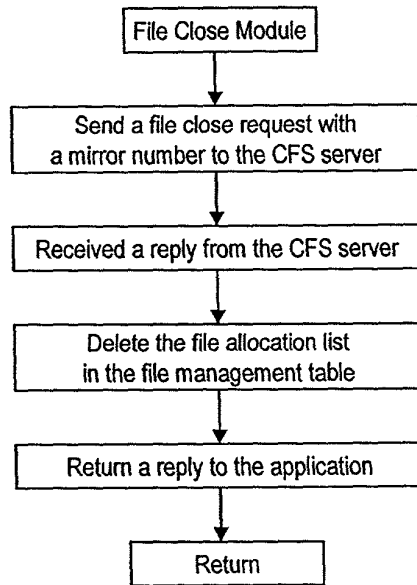


Figure 21 File Close Module

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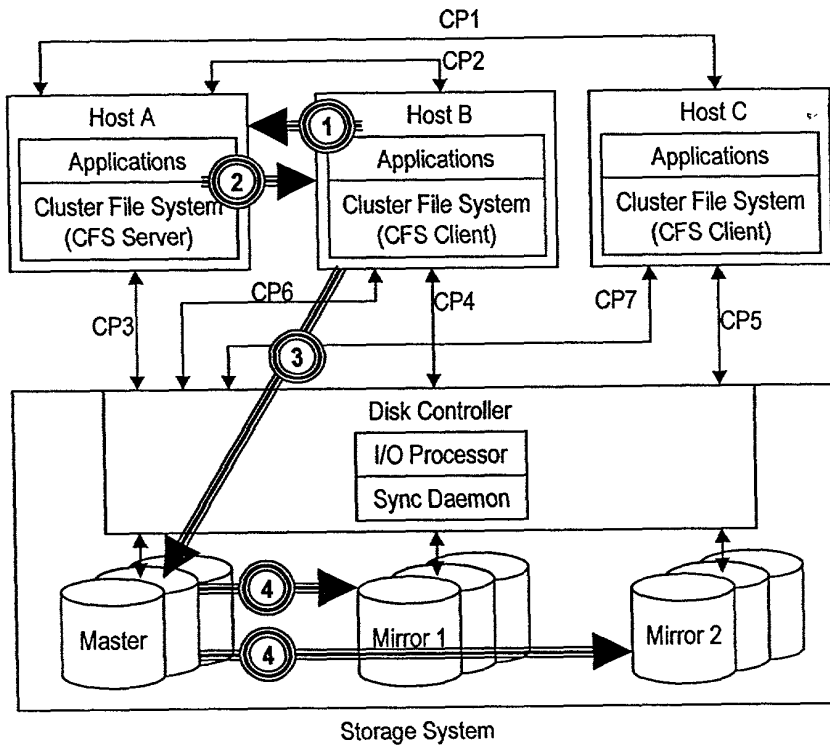


Figure 32 Synchronous Data Write Sequence where Mirrors in the Same Storage System

Data Write Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Write Data to Master
- ④ Copy Data to Mirrors by Sync Daemon

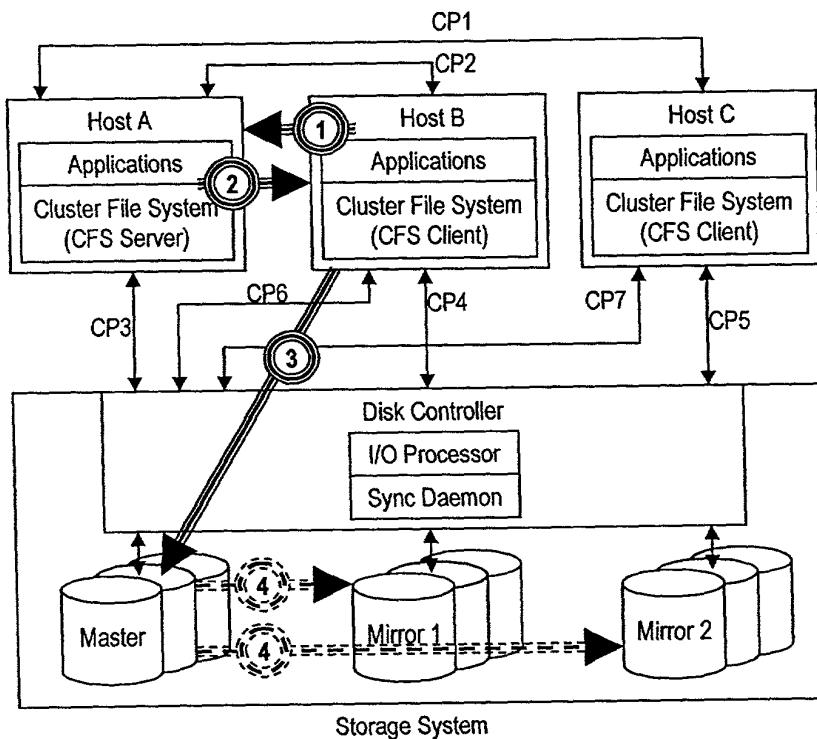


Figure 23 Asynchronous Data Write Sequence where Mirrors in the Same Storage System

Data Write Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Write Data to Master
- ④ Copy Data to Mirrors by Sync Daemon

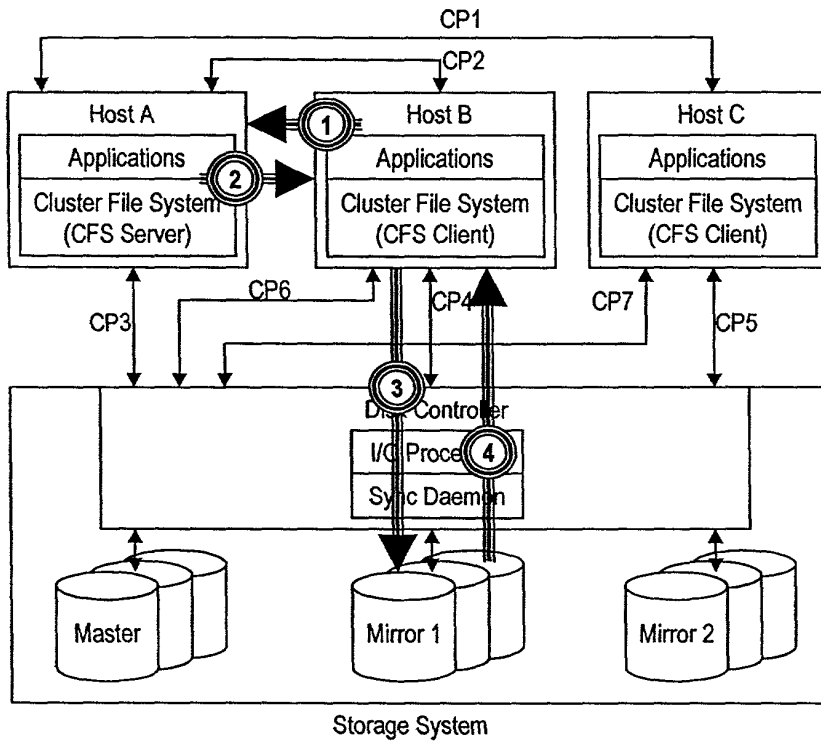


Figure 24 Data Read Sequence where Mirrors in the Same Storage System  
(A Case of Synchronous Data Write or Async Data Write and Data is on Mirror)

Data Read Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Read Data from Mirror 1
- ④ Send Data to Host

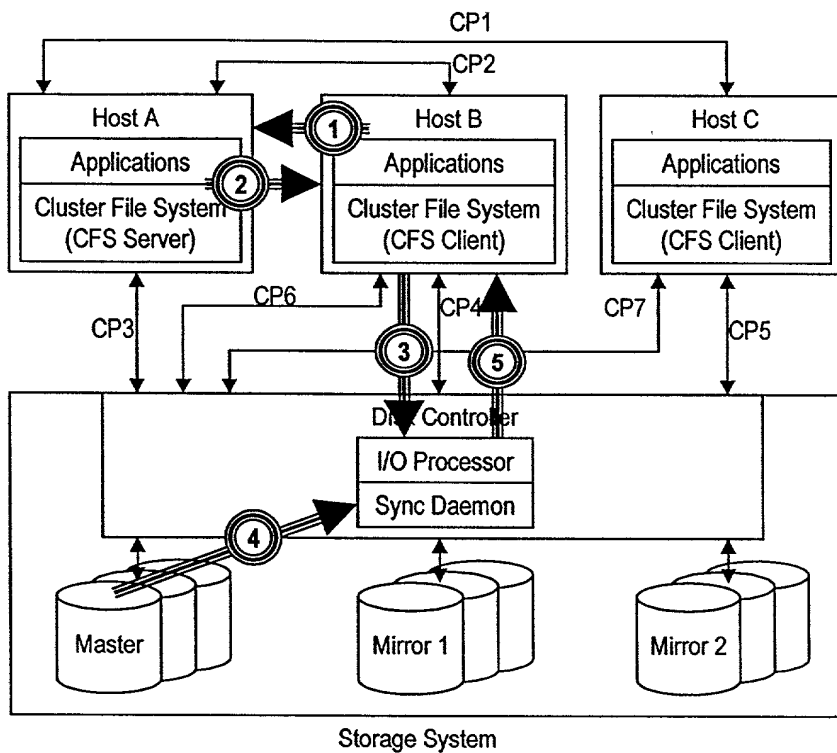


Figure 25 Data Read Sequence where Mirrors in the Same Storage System  
(A Case of Asynchronous Data Write and Data is not on Mirror)

Data Read Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Read Data from Mirror 1
- ④ Read Data from Master by I/O Processor
- ⑤ Send Data to Host

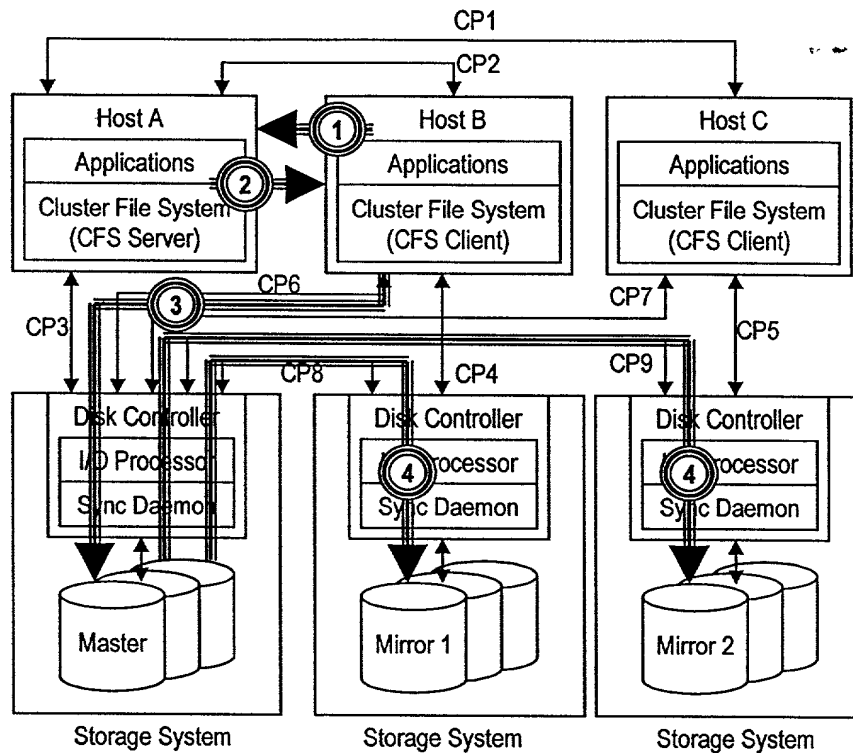


Figure 2.6 Synchronous Data Write Sequence where Mirrors on Different Storage Systems

Data Write Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Write Data to Master
- ④ Copy Data to Mirrors through Communication Path

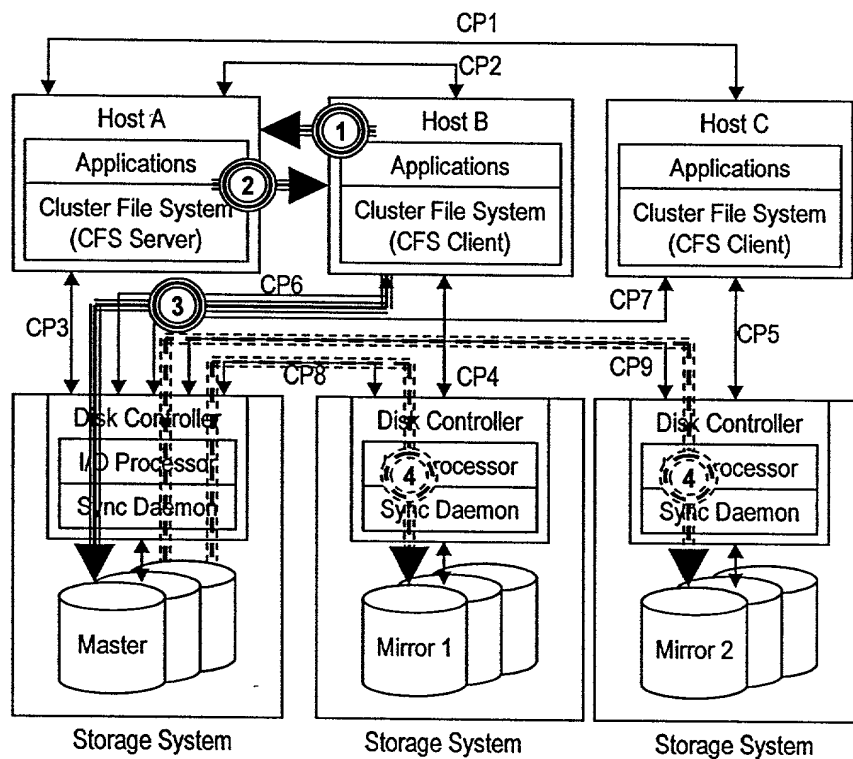


Figure 27 Asynchronous Data Write Sequence where Mirrors on Different Storage Systems

#### Data Write Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Write Data to Master
- ④ Copy Data to Mirrors through Communication Path by Sync Daemon

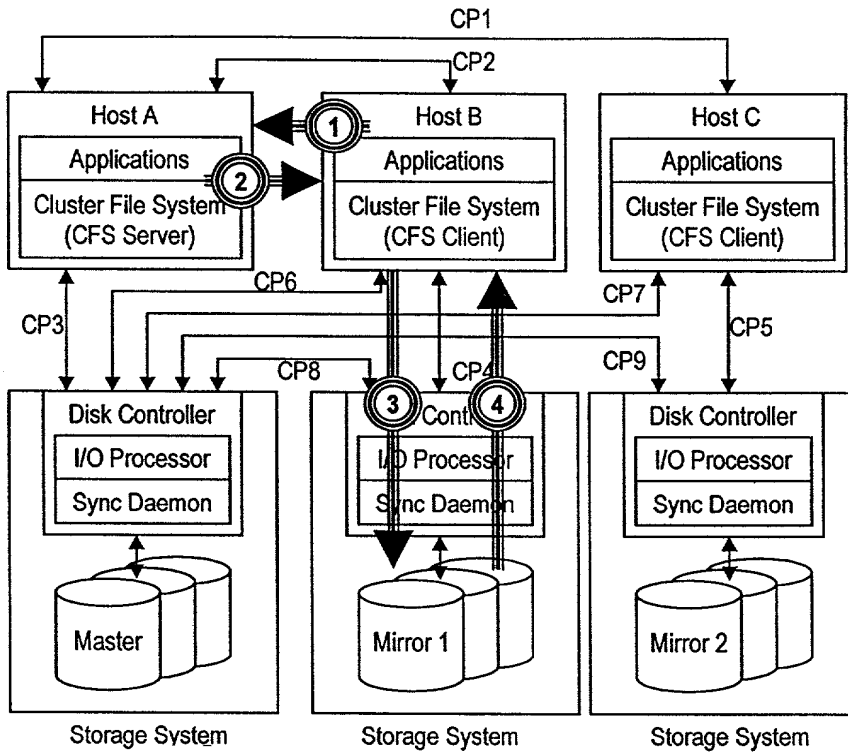


Figure 28 Data Read Sequence where Mirrors on Different Storage Systems  
(A Case of the Synchronous Data Write or Async Data Write and Data is on Mirror)

#### Data Read Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Read Data from Mirror 1
- ④ Send Data to Host

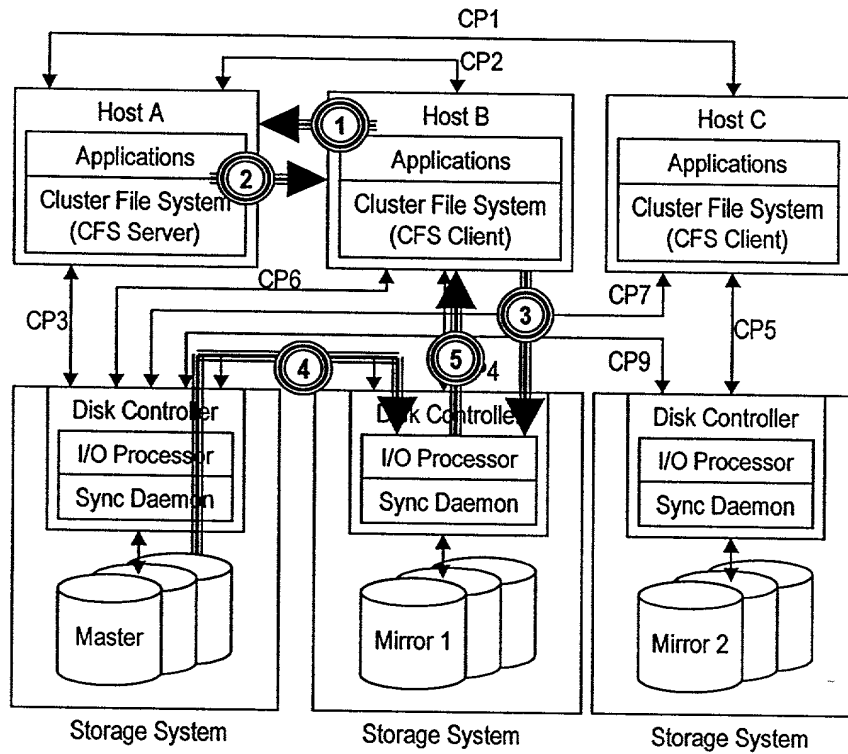


Figure 29 Data Read Sequence where Mirrors on Different Storage Systems  
(A Case of the Asynchronous Data Write and Data is not on Mirror)

#### Data Read Sequence

- ① Request File Allocation List
- ② Return File Allocation List
- ③ Read Data from Mirror 1
- ④ Read Data from Master by Sync Client
- ⑤ Send Data to Host

|                  |            |                       | Same Storage System | Different Storage Systems |
|------------------|------------|-----------------------|---------------------|---------------------------|
| Sync Data Write  | Data Write |                       | Figure 22           | Figure 26                 |
|                  | Data Read  |                       | Figure 24           | Figure 28                 |
| Async Data Write | Data Write |                       | Figure 23           | Figure 27                 |
|                  | Data Read  | Data is in Mirror     | Figure 24           | Figure 28                 |
|                  |            | Data is not in Mirror | Figure 25           | Figure 29                 |

Figure 30 Relationship between Figures and Read/Write Cases

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| Pair Name | Mirror ID | SS ID | Vol ID | Cluster #1 | Cluster #2 | Cluster #3 | ..... |
|-----------|-----------|-------|--------|------------|------------|------------|-------|
| pair1     | Mirror 1  | 1     | 1      | Valid      | Invalid    | Valid      | ..... |
|           | Mirror 2  | 2     | 2      | Invalid    | Invalid    | Valid      | ..... |
|           | ⋮         | ⋮     | ⋮      | ⋮          | ⋮          | ⋮          | ..... |
|           | Mirror N  | 2     | 2      | Invalid    | Valid      | Valid      | ..... |
| pair2     | Mirror 1  | 1     | 1      | Valid      | Valid      | Valid      | ..... |
| ⋮         | ⋮         | ⋮     | ⋮      | ⋮          | ⋮          | ⋮          |       |

Figure 31. Bitmap Table

FILE NO. 20050660

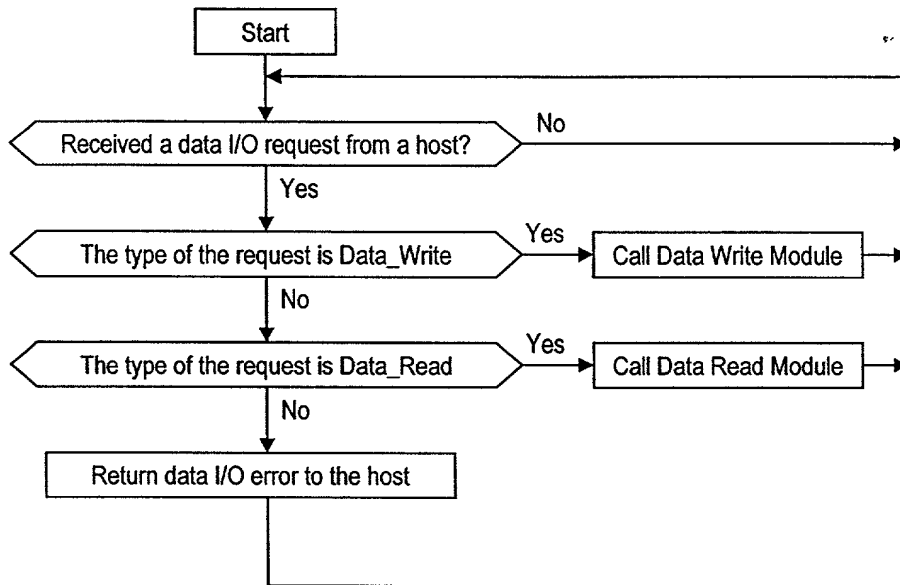


Figure 32. Process Sequence of I/O Processor

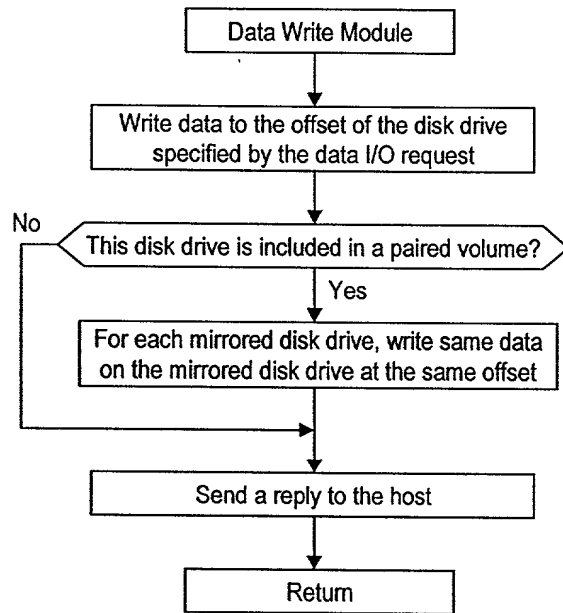


Figure 33. Data Write Module for Synchronous Data Write

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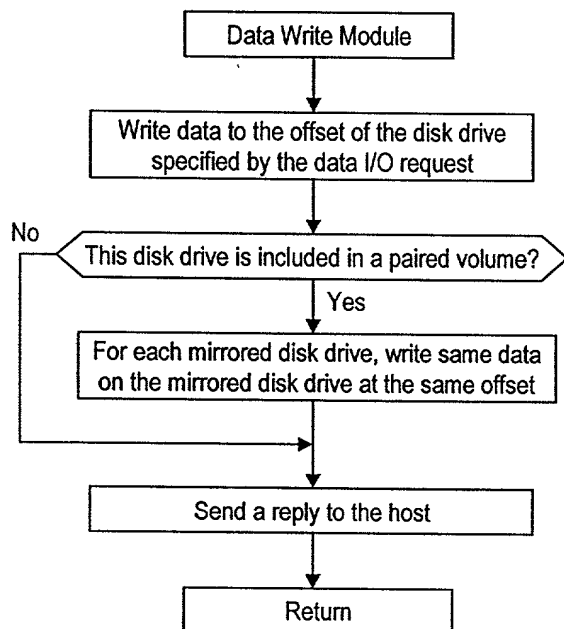


Figure 33. Data Write Module for Synchronous Data Write

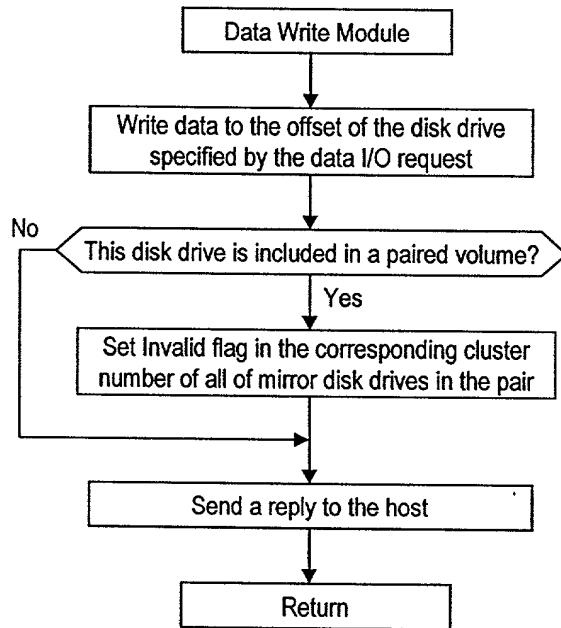


Figure 34. Data Write Module for Asynchronous Data Write

Figure 35. Data Read Module for Synchronous Write

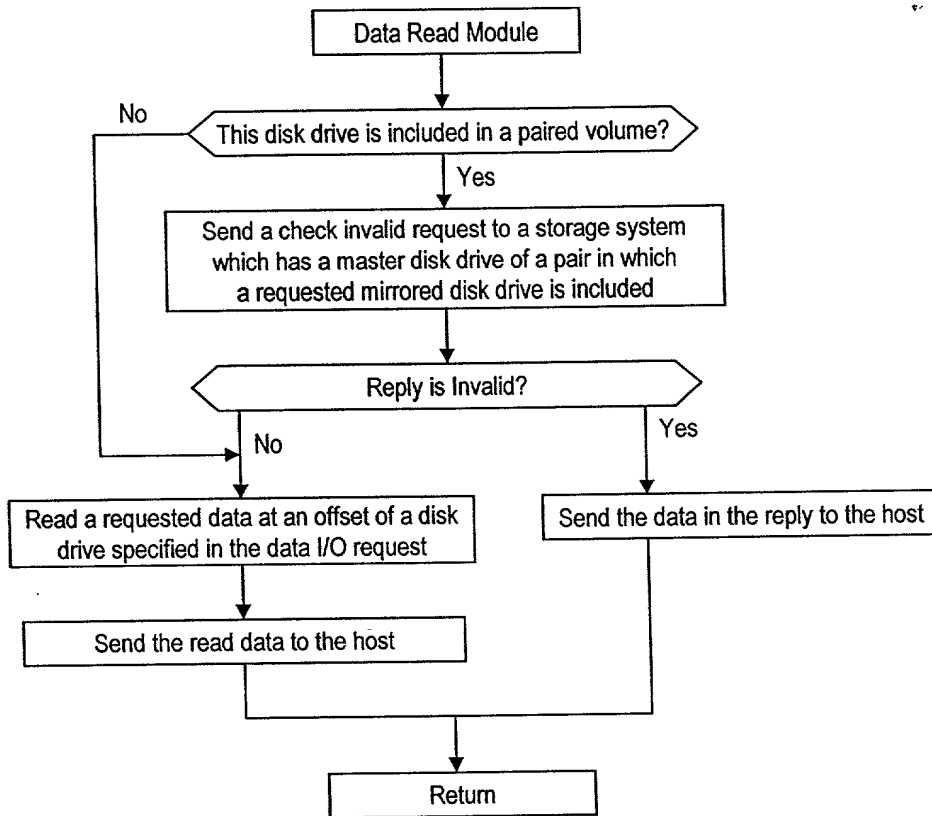


Figure 36. Data Read Module for Asynchronous Write

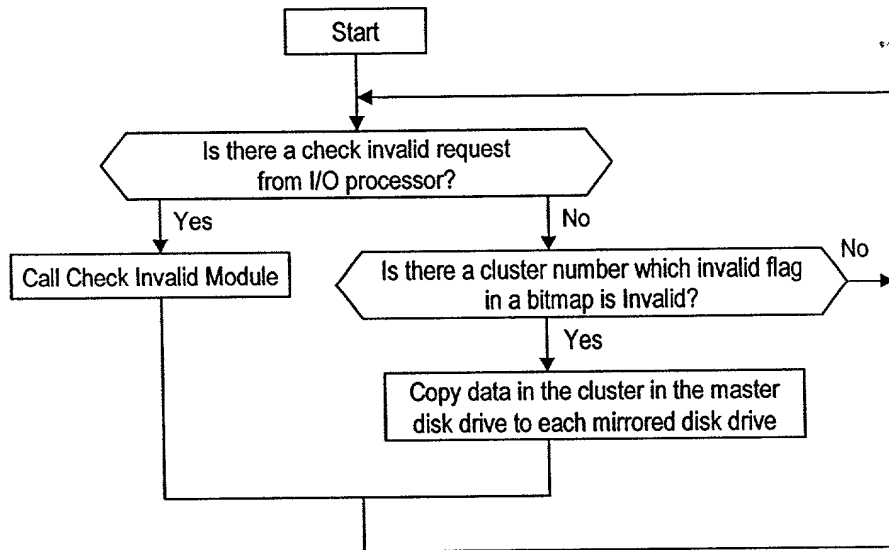


Figure 37. Process Sequence of Sync Daemon

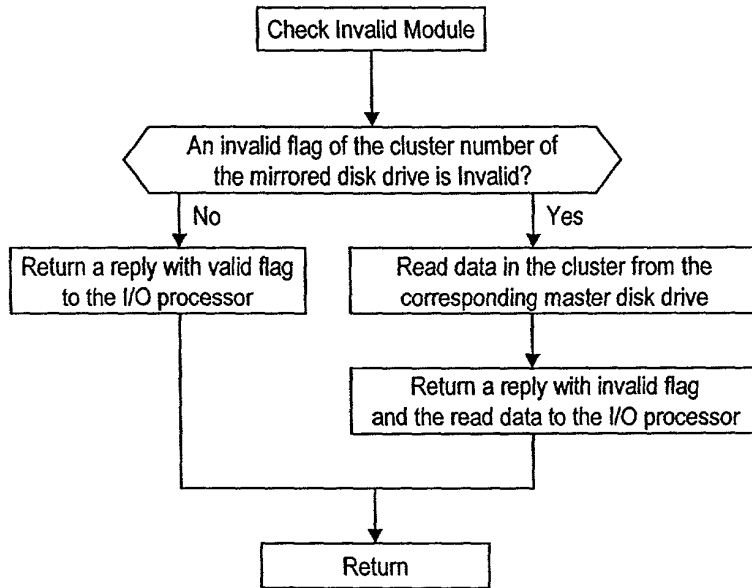


Figure 38. Check Invalid Module

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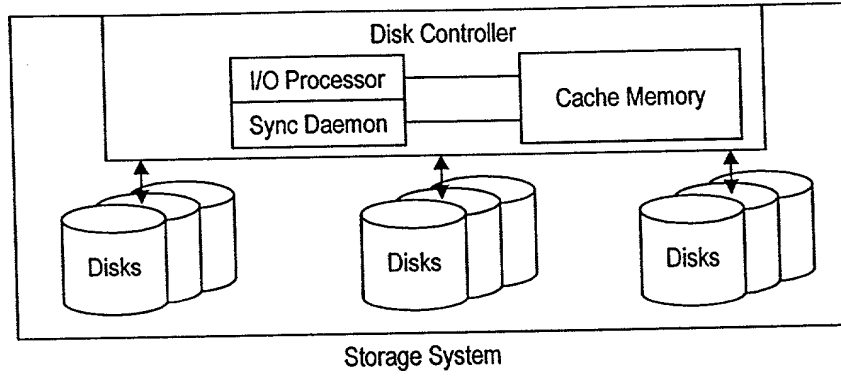


Figure 39. Storage System with Cache Memory

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